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No. 5] [1916

XXII.—A PHOMA DISEASE OF LAVENDER.

STUDIES FROM THE PATHOLOGICAL LABORATORY: II.

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(With Plates.)

In the early summer of 1915 my attention was drawn to two large beds of *Lavandula officinalis* in which practically every plant was dying. Affected shoots presented a dry, dirty brownish-grey colour, and the epidermis tended to split away in minute silvery flakes. The leaves on a diseased stem preserved their normal appearance for some time and then somewhat rapidly wilted and became brown and shrivelled. All portions of the plant above the dry discoloured areas died. This is a not uncommon disease of lavender, and at times is the cause of serious loss to growers. At first individual shoots only are affected but finally the complete plant is involved, and in a bed the disease rapidly spreads until all the plants are in a weak or dying condition.

A careful examination of a diseased shoot showed that the shrivelled portion of the stem under the flaking epidermis was studded with very minute blackish-brown points which proved to be the pycnidia of a fungus ramifying in the tissues. This fungus was identified as *Phoma lavandulae*, Gabotto, a species hitherto unrecorded in England.

The only other determination of this fungus is that of its original discoverer, who gives the following description of it.

Phoma lavandulae, nov. sp.

"Picnidiis corticalibus, solitaris, lenticularibus, prominulis atris. Basidiis hyalinis, acicularibus 12–14 μ long. Sporulis fusoideis, 2-guttulatis, hyalinis, 4–2 μ."

"In ramis Siccis Lavandulae officinalis Chaix. Mirabello in Pedem."*

As this description represented our knowledge of the fungus, no figures having been published, and as the fungus was sus-

* Dottore L. Gabotto. Contribuzione alla Flora Micologica Pedemontana. Nuovo Giorn. Bot. Ital., vol. xii., p. 69. 1905.

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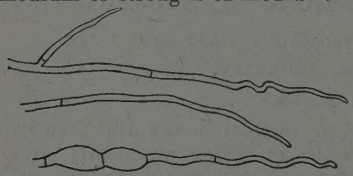
pected of pathogenic qualities, it was considered advisable to make a more detailed investigation of its morphology and biological relationships.

Life History of the Fungus in pure culture.

The pycnospores usually germinate in a period of from one to three or four hours on nutrient media at room temperature (approximately 14–16° C.), and a moderate mycelial growth occurs. At first this is pure white but with increasing age becomes slightly grey. The medium directly beneath the colony is coloured brownish-red or variously from this to a dirty grey, the coloration not being constant for any particular nutrient medium or strength of medium.

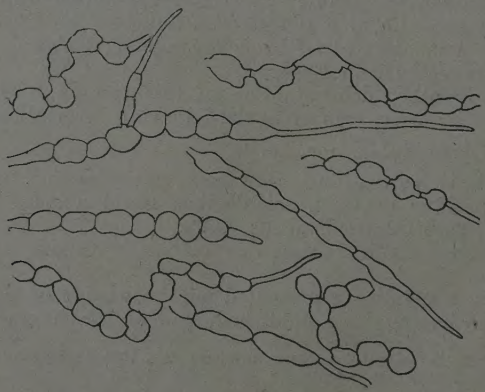


1. Undulate terminal cells from mycelium growing on potato gelatine. (Swift $\frac{1}{8}$ obj. × III. eyepiece.)

The superficial hyphae are hyaline and septate; and smooth and regular with the exception of the terminal cell which is frequently undulate. (*Text Fig.* 1.)

The cells are uninucleate and the transverse walls are formed by the ingrowth of a ring-like diaphragm of cell wall substance. (*Pl.* V. *Fig.* 1.) The cell nucleus contains one or very rarely two nucleoli, and occasional granules which stain with nuclear stains. Fat is present in the vacuoles of the cytoplasm and not infrequently there is distinct evidence of glycogen. The cell walls stain dull yellow with Schultze's chlor-zinc-iodine solution.

The mycelium penetrates the nutrient medium to a depth of from five to eight millimetres, and the submersed hyphae are often very irregular with nodulose, barrel-shaped or globular cells. (*Text Fig.* 2.)



2. Irregular forms of submersed hyphae from various media. (Swift $\frac{1}{8}$ obj. × III. eyepiece.)

When growing on a nutrient liquid such as aqueous extract of fresh lavender shoots, the character of the submersed hyphae is maintained although not in so exaggerated a form.

After a few days' growth the superficial hyphae begin to abstrict conidia, which at first are hyaline and thin-walled, but later become thick-walled and dark brown in colour.

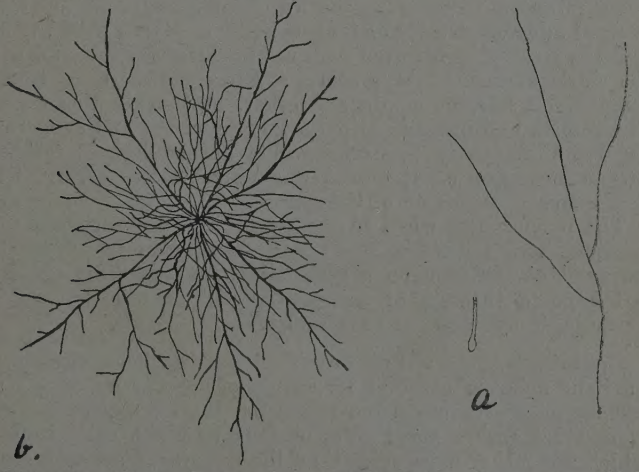
In about 14 to 17 days pycnidial formation occurs.

Under unusual conditions or with age the cells of the hyphae enlarge, become thick-walled and brown and very easily separate forming chlamydospores.

The fungus grows best at a temperature of about 18–20° C.

Pycnospores,—The pycnospores are hyaline, fusoid in shape, and frequently contain one or two vacuoles. (*Pl.* VI. *Fig.* 1.) Their average measurement is 4 × 2 μ, but very often spores of 5 μ and occasionally of 6 μ in length may be found. Their walls stain bluish with Schultze's chlor-zinc-iodine solution and the contents appear to consist largely of glycogen.

The germ tube may be protruded from the side or from the end in which case the spore appears merely to elongate into a hypha. (*Pl.* VI. *Fig.* 1. *Text Fig.* 3*a*.).



3*a*. Pycnospore fifteen hours after germination. Spore more highly magnified at the left side. (Swift $\frac{1}{6}$ obj. × I. eyepiece.)

3*b*. The same colony after three days' growth. Note the main lines of hyphae, which perhaps correspond to the distributive hyphae when the fungus is growing on its host. Spores in a hanging drop of lavender extract in a Van Tieghem cell at room temperature. (Swift $\frac{2}{3}$ obj. × I. eyepiece.)

The direction of the germ tubes is quite indiscriminate and does not appear to be conditioned either by the incidence of light rays or the local proximity of nutrient matter.

In distilled water very slender unbranched germ tubes were produced which never developed to a greater length than 35 μ. In tap water slender feebly branching germ tubes were protruded, growing to about 150 μ in length. In bouillon few spores germinated and the feeble germ tubes produced did not exceed 95 μ

in length. The spores very frequently became swollen and irregular. In the majority of aqueous plant extracts, or these with agar and gelatine, germination freely occurred, and a moderate but never luxuriant growth resulted. (*Text Fig.* 3*b*.)

In pure nitrogen-free media such as glucose or levulose, germination was delayed, and was then only very feeble, the germ tube rarely exceeding 20–25 μ. Normal germination was brought about by the addition of nitrogen containing compounds such as ammonium tartrate, peptone or asparagine, but not potassium nitrate nor ammonium chloride.

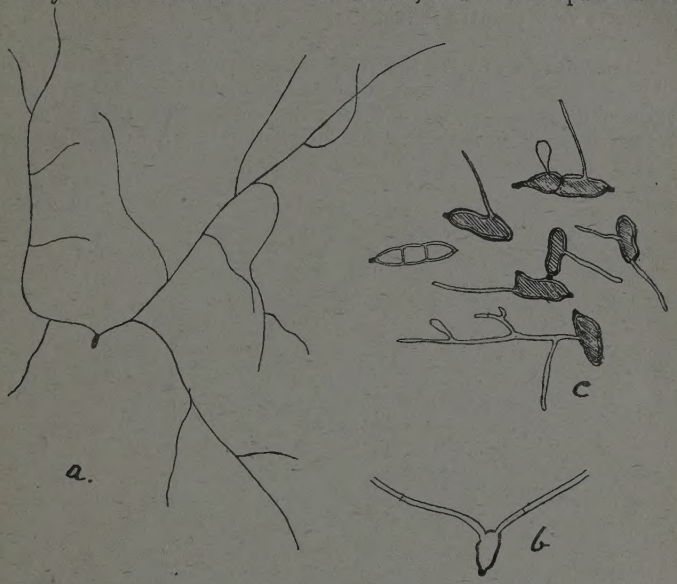
Centrifugalisation for ten minutes had no visible effect on the spores. After fifteen minutes a slightly decreased power of germination was noticeable and after twenty-five to thirty-five minutes' treatment not more than one half the spores were capable of producing germ tubes. The inhibited spores stained an unusually dark brown colour with Schultze's chlor-zinc-iodine solution, but otherwise no difference could be detected.

A few observations were made on the effect of various chemical fumes on the germinative capacity of spores air dried from a suspension in water on a cover slip. In each case the latter was inverted over the mouth of the bottle containing the liquid for three minutes, exposed to the air for five minutes and then a drop of aqueous extract of lavender shoots placed over the spores and the cover slip inverted over a Van Tieghem cell and kept in the dark at room temperature. After exposure to formalin, toluene, benzole, ammonia and ether, no germination occurred. Chloroform and creosote killed a large number of the spores and the remainder only produced feeble germ-tubes. Acetone and turpentine appeared to retard and enfeeble the germination of only a small proportion of the spores.

The pycnospores when in the pycnidium are very much more resistant to all adverse conditions than when in suspension in water or air dried upon a glass slide, and pycnidia on a shoot left exposed throughout the winter still contained a very few germinable pycnospores on March 3rd.

Conidia.—After a few days' growth in pure culture on a nutrient medium conidial formation occurs. Any of the aerial hyphae may give origin to conidia but their production is chiefly from erect rather short hyphae four to eight cells in length, which are rather more stout than the remaining aerial mycelium. (*Pl.* VI. *Fig.* 2.) The first conidium is usually budded off from the end of the terminal cell, but very soon other conidia are abstricted indiscriminately from any portion of any cell towards the tip of the filament. Very frequently a conidium while still attached to the conidiophore gives origin, often from its side, to other conidia. The conidia may be somewhat irregular in shape, but are chiefly fusoid and a distinct neck is to be found at the point of abstriction. (*Pl.* VI. *Figs.* 2, 3.) They are commonly unicellular and uninuclear, but occasionally a spore consisting of two or three cells may be seen. (*Text Fig.* 4*c*.) When first formed they are hyaline and thin-walled and remain in this condition for some time, especially if they become free from the conidiophore.

Finally their walls thicken and become dark brown or brownish-grey. Ultimately the cells of the conidiophore itself not infrequently become thick-walled and brown, and when separated are



4*a*. Thick-walled brown conidium twenty-four hours after germination (Swift $\frac{1}{6}$ obj. × I. eyepiece.)
4*b*. Spore of same. (Swift $\frac{1}{6}$ obj. × I. eyepiece.)
4*c*. Thick-walled brown conidia five hours after germination. Note the multi-cellular conidia. (Swift $\frac{1}{6}$ obj. × I. eyepiece.)
The spores had all been subjected to a temperature below zero and then placed in a hanging drop of lavender extract in a Van Tieghem cell and left at room temperature. The conidia were from a culture on potato gelatine.

hardly to be distinguished from the brown conidia in appearance and germinative capacity.

Usually one, and rarely more than two, germ tubes are protruded from any portion of the spore and the growth is stouter and more frequently branched than that described for the pycnospores. (*Text Figs.* 4*a*, *b*, *c*.) The conidia measure 12–20 μ by 3–6 μ.

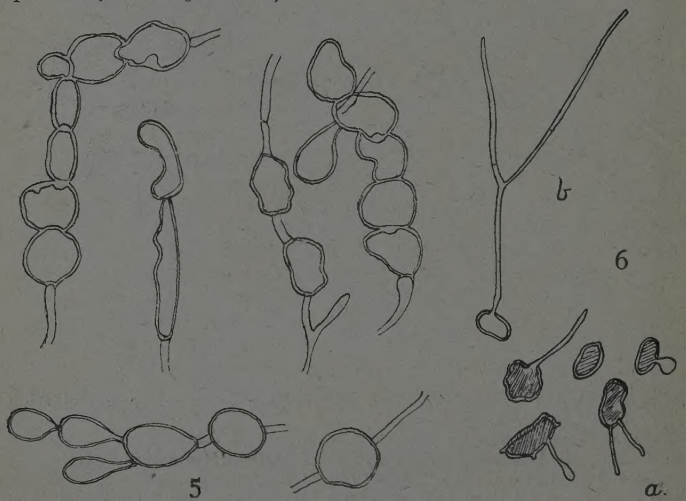
Hyaline Conidia.—The hyaline conidia approximate very closely to the pycnospores in their germinative capacity, but are perhaps slightly more resistant to adverse conditions.

Their walls stain yellowish-brown with Schultze's chlor-zinc-iodine solution and their contents consist largely of glycogen.

Thick-walled brown Conidia.—In water and nutrient media these spores do not germinate under a period of at least twenty-five days. This resting period may be curtailed or even eliminated by subjecting the spores to a temperature below freezing point or to the action of artificial gastric or pancreatic juice. The spores are equally susceptible with the pycnospores

to the influence of centrifugalisation, but much more resistant to desiccation and the action of chemical fumes. When the resting period of the spores has been eliminated their resistant quality is very greatly reduced.

Chlamydospores.—If the fungus be grown on a very stiff agar medium (*e.g.*, 5 per cent. potato agar), the colonies seldom attain a diameter of more than two centimetres, and after ten or twelve days' growth the mycelium breaks up into chlamydospores. (*Text Figs.* 5, 6.)



5. Chlamydospores from a culture on 4 per cent. lavender agar.
6*a*. Chlamydospores five hours after germination.
6*b*. Chlamydospore fifteen hours after germination.
The chlamydospores were from an old culture on prune gelatine. They were subjected to the action of trypsin in a faintly alkaline medium for three hours, washed and placed in a hanging drop of lavender extract in a Van Tieghem cell, and left at room temperature.
(All figs. Swift $\frac{1}{6}$ obj. × III. eyepiece.)

The cells become irregularly swollen, spindle-shaped, barrel-shaped, or even globular. Their walls become thickened, often very irregularly, and their colour changes to brown. The mycelium becomes brittle and easily disintegrates. This form of sporulation tends to occur on all media when the culture is old or growing under unfavourable conditions. The chlamydospores germinate in water and the majority of nutrient media, but only after a minimum period of twenty-one days and a usual period of twenty-five to thirty days. As in the case of the thick-walled brown conidia, this resting period may be eliminated by freezing or the action of gastric or pancreatic juice. In resistant quality to adverse conditions the chlamydospores approximate to the thick-walled brown conidia.

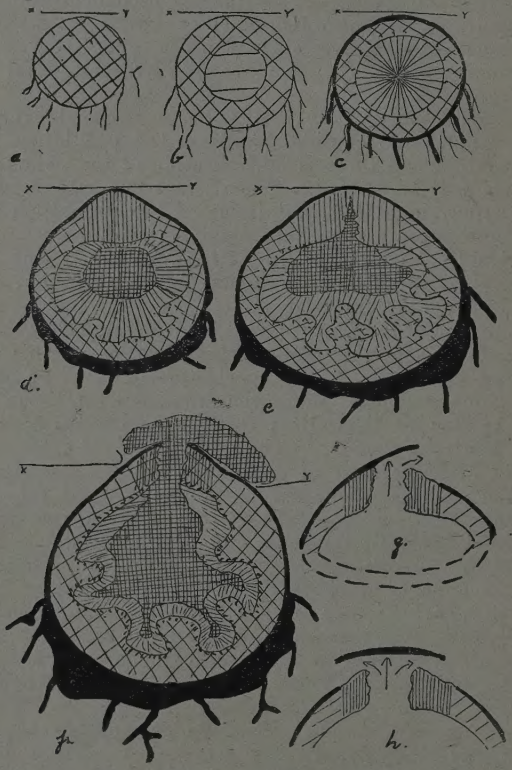
Formation of Pycnidia.—Pycnidial formation, although abundant on diseased plants, is only sparingly and inconstantly

found when the fungus is grown in pure culture on a nutrient medium. No attempt was made to elucidate the cytology of the process of development. The pycnidia originate as small knots or tangles of hyphae.—(*Pl.* V., *Figs.* 2, 3, 4)—the separate strands interweaving very intimately to form a compact mass. This increases in size, the hyphae become abundantly septate, and those on the periphery become slightly thick-walled and assume a brownish-black coloration. (*Text Fig.* 7*c*.)

The inner tissues are very delicate and show a radiate arrangement which is demarcated from a wall tissue. (*Text Figs.* 7*b*, *c*.)

The central portion of this delicate tissue is very finely divided. For some considerable time the pycnidium is without orientation and there is no indication of the point at which the ostiole will be formed. When about one-half to two-thirds grown, a portion of the wall tissue of the pycnidium develops rather more rapidly than the remainder and bulges internally and externally. (*Text Fig.* 7*d*. *Pl.* V., *Fig.* 5.) The pycnidia grow immediately below the surface of the medium, only the merest film of the nutrient matter covering them, and the swollen portion of the wall is found immediately below this film—*i.e.*, remote from the mass of substratum. This swelling is covered externally by the carbonaceous layer of peripheral tissue which encloses the pycnidium, but the tissue of the swollen portion of the wall is delicate, this being most marked in its central portion. The formation of this swelling is the first visible sign of orientation in the pycnidium, and marks the position of the future ostiole. About this stage of development the basal portion of the wall of the pycnidium begins to increase in thickness and hyphae grow out from the wall into the surrounding medium, so that not infrequently the pycnidium appears to be seated on a small stroma or basal pad of tissue. (*Text Fig.* 7*c*, *d*, *e*, *f*.) At the same time folds of the wall grow into the central tissues. The wall is clearly divided into a peripheral irregular carbonaceous layer, one to three or four cells thick, a middle pseudoparenchymatous tissue four to six cells in thickness, and an inner very delicate hymenial lining from which spring the basidia. (*Pl.* V., *Fig.* 5. *Pl.* VI., *Figs.* 4, 5.) These have exceedingly delicate walls and are turgid, with a dense very finely granular protoplasm. The centre is filled with a dense mass of turgid hyaline very minute cells, forming the extremities of the basidia and being the first pycnospores. The actual formation of the ostiole—(*Text Fig.* 7*f*)—is brought about partially by the disintegration or possible autolysis of the very delicate central cells of the "ostiolar tissue" and partly by the pressure exerted by the internal elements, which on the rupture of the ostiole pour forth in a diffuse mass. The peripheral layer of thick-walled brown cells originally covering the ostiole is either torn completely free—(*Text Fig.* 7*h*)—ruptured—(*Text Fig.* 7*f*., *Pl.* II., *Fig.* 4)—or pushed over to one side—(*Text Fig.* 7*g*). Pycnospore formation continues for some considerable time after the first rupture of the ostiole. Not infrequently two or three pycnidia in immediate contiguity fuse

together during their early stages of development and the walls separating them are absorbed into the central sporogenous tissues. When mature the irregular fruit may dehisce by one central ostiole or each loculus may possess its own opening. The development of the pycnidium is diagrammatically represented in Text figure 7.



7. Diagrammatic representation of the development of the pycnidium. The line x—y represents the surface of the culture medium or epidermis of the host.

a. Undifferentiated pseudoparenchymatous mass of mycelium.

b. The central tissues demarcated from the wall tissue.

c. The wall tissues differentiate into three layers and the central tissues show a radial arrangement.

d. The pycnidium orientated by the development of a delicate mass of tissue immediately below the outer film of substratum, and the growth of hyphae from the pycnidium to form a basal "stroma." The central portion of the inner tissues becomes very finely divided, and projections or tongues of wall tissue grow into the delicate inner tissues.

e. Differentiation is more marked and the ostiole begins to form.

f. On the final rupture of the ostiole the pycnospores issue forth in a diffuse mass.

g. Rupture of the ostiole by the pushing over to one side of the outer wall layer.

h. Rupture of the ostiole by the tearing free of the outer wall layer.

The diameter varies from 80-150 μ, and the pycnidium may be pear-shaped, globular, or oblately spheroidal. The basidia are 12-14 μ long and more or less acicular, with a swollen base, or phial shaped. (*Pl.* II., *Fig.* 5.)

A few observations were made with a view to ascertaining what factors condition the orientation of the pycnidium, for the latter in early stages of its development is isodiametrical.

Two plate cultures were supported on their edges so that the immature pycnidia on the one plate received the light through the medium on their potential basal sides, whilst those on the other plate received it from above on their potential ostiolar sides. The face of each plate remote from the light was rendered opaque. The development of the pycnidia in both cases was perfectly normal, the ostiole being away from the nutrient substratum.

A portion of a plate culture containing developing pycnidia was cut out, placed on the bottom of a small sterile bottle, and this exhausted as far as possible of air. The pycnidia matured in a perfectly normal manner.

A plate culture with young pycnidia was flooded with its own nutrient medium (potato gelatine) to a depth of about six millimetres, so that the developing structures were in a middle plane. The pycnidia matured and were rather larger than usual, and hyphae from the wall grew out into the overlying food layer. The orientation of the pycnidia was completely disturbed, no definite ostiole was formed, and in many cases the wall was quite irregularly burst to allow of the exit of the spores. In other cases no opening of any kind was formed.

When a very thin film of nutrient material was poured over a plate containing developing pycnidia or the added layer was very frothy from violent shaking the disturbing effect, although still apparent, was not nearly so well marked.

These observations, though somewhat primitive and inconclusive, would appear to indicate that relation to food supply, and not light or aeration, is the primary factor conditioning the orientation of the pycnidium.

Infection Experiments.—Infection experiments were carried out on *Lavandula officinalis*, using pure cultures of the fungus grown on lavender gelatine. The results of this work are summarised below.

Experimental Infections on Lavandula officinalis.

Treatment.	Spore.	First Distinct Signs of Infection.	Result.
1. Suspension of spores in sterile water brushed on the surface of 12 shoots.	Pycnospore	On 11 shoots in 9-10 days. On 1 shoot in 15 days	Pycnidial formation in about 31 days.
	Hyaline Conidium.	On 10 shoots in 10-11 days. On 2 shoots in 17 days	Pycnidial formation in about 37 days.
	Brown Conidium.	None after 30 days ...	None.
	Chlamydospore.	None after 30 days ...	None.

Treatment.	Spore.	First Distinct Signs of Infection.	Result.
2. Spores digested in artificial gastric juice for 12 hours; then washed in sterile water and brushed on the surface of 12 shoots.	Pycnospore	On 1 shoot after 14 days.	Slight infection of 1 shoot. No pycnidial formation. Feeble mycelium in shoot determined as *Phoma lavandulae*.
	Hyaline Conidium.	None after 30 days ...	None.
	Brown Conidium.	On 5 shoots in 12 days On 1 shoot in 18 days	Pycnidial formation on 4 shoots after about 40 days. Mycelium in 2 remaining shoots identified as *Phoma lavandulae*.
	Chlamydospore.	On 7 shoots in 11-12 days.	Pycnidial formation on 6 shoots after about 40 days. Mycelium in remaining shoot identified as *Phoma lavandulae*.
3. Suspension of spores in sterile water frozen for about 14 minutes, and subsequently brushed on the surface of 12 shoots.	Pycnospore	None after 30 days ...	None.
	Hyaline Conidium.	None after 30 days ...	None.
	Brown Conidium.	On 7 shoots in 14 days	Pycnidial formation on 3 shoots after about 40 days. On 1 shoot after about 60 days. Mycelium in 3 remaining shoots identified as *Phoma lavandulae*.
	Chlamydospore.	On 8 shoots in 12-14 days. On 1 shoot in 17 days	Very sparing pycnidial formation on 5 shoots after about 40-43 days. Mycelium in 3 remaining shoots identified as *Phoma lavandulae*.

No definite controls were kept, but all the inoculated plants were either amongst others in a bed or had other plants in their immediate vicinity. The disease only appeared on those shoots experimentally infected. Where no pycnidial formation occurred the infected shoots were carefully sectioned and the mycelium present compared minutely with mycelium definitely known to be that of *Phoma lavandulae*.

Similar infection experiments were carried out on *Lavandula spica* with approximately equal results. Infection experiments were made with pycnospores only on *Lavandula vera* and *Lavandula lanata*, and pycnidial formation obtained in both cases.

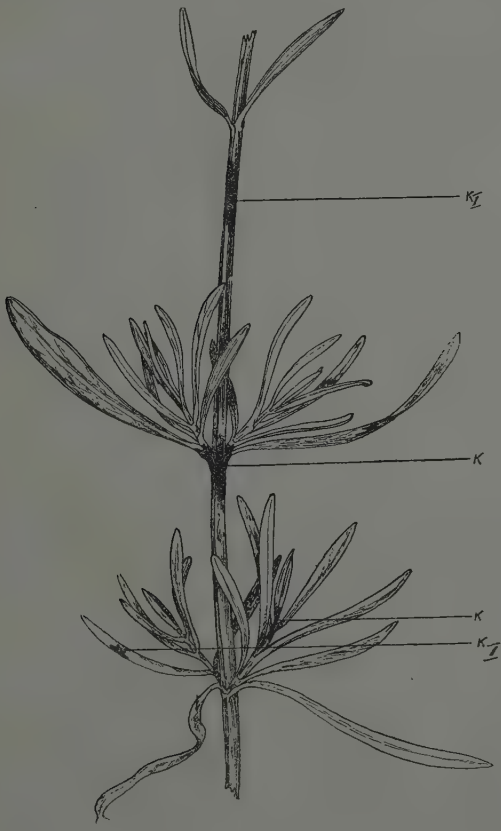
Attempts were made to infect the following plants: *Chrysanthemum* sp., *Salvia* sp., *Vinca* sp., *Artemisia* sp., *Santolina* sp., *Aristolochia* sp., *Aster* sp., *Malva* sp., *Helianthus* sp., *Lindera* sp., *Crataegus* sp., *Calluna* sp., and *Syringa* sp.

The first trials were made with pycnospores directly transferred from lavender shoots, and these were placed both on the normal surface or in wounded tissues. No infections occurred.

Subsequently the fungus was transferred to a mush made by grinding the externally sterilised and washed fresh tissues of the individual plants with fine sterile sand in a mortar. No growth occurred on mush of *Artemisia*, *Santolina*, *Helianthus*,

and *Calluna*, and on each of the others but a slight growth was obtained. This appeared most promising on *Salvia*, *Vinca*, *Aster*, and *Malva*, and subcultures were made to freshly prepared mush of these plants. Portions of the most vigorously growing mycelium with a little mush were then placed on wounded and unwounded surfaces of the suitable plants. No infection occured, and subsequent examination showed that the mycelium in every case had died after growing for a little time in the mush.

It would appear, therefore, that the fungus is pathogenic to the genus *Lavandula*, and probably confined to this genus.

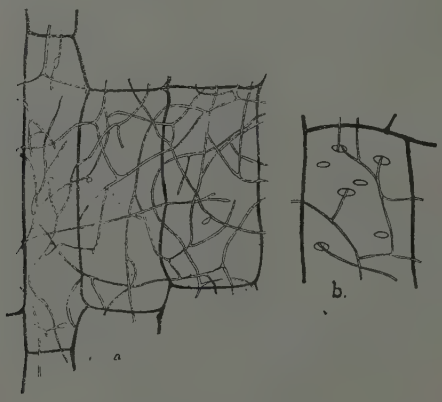


8. Shoot of *Lavandula officinalis* infected at K_1 with pycnospores and at K with thick-walled brown conida treated with gastric juice. Shoot drawn eighteen days later. Pycnidia were subsequently formed on the stem portion but not on the leaves. ($\frac{2}{3}$ normal size.)

Relation of Fungus to Tissues of Host.—The fungus is primarily found in the stem tissues of its host. Rarely the leaf shows infection distinct from its supporting stem, and this

may occasionally be produced by artificial inoculation. (*Text Fig.* 8.) Pycnidia have never been found on the leaves.

At first the fungus mycelium spreads in the cortex of the host, radiating in fairly well defined "strands" or "tracks" from the point of infection. Much of this early mycelium may be regarded as distributive in that it consists of elongate little branched hyphae which penetrate the tissues principally in a direction parallel to the axis of the host. Later the mycelium is freely branched and forms a complex ramifying system in the host tissues. From the cortex the hyphae pass to the phloem groups and thence along the medullary rays to the pith, in which the fine mycelium is very abundant. (*Text Fig.* 9.)



9*a*. Hyphae of fungus ramifying in pith cells of host.
9*b*. Hyphae passing through pits in the walls of pith cells of host. The hyphae are very slender and freely branched.
(Swift $\frac{1}{6}$ obj. × III. eyepiece, reduced by one half.)

From the medullary rays and phloem groups the hyphae penetrate the xylem elements, branching little, but either running longitudinally through them or crossing at right angles to their length.

The hyphae enter the cells through the pits which are abundantly present in the walls—(*Text Fig.* 9*b*)—and where a hypha passes through a deep pit as in the walls of sclerenchymatous or tracheidal elements a definite constriction is visible. (*Pl.* V., *Figs.* 6, 7, 8.)

At point of entry and exit to such a pit an appressorium like dilation is present in the hypha.

The cells of the cortex, phloem, and cambium are rapidly killed and collapse—(*Pl.* V., *Fig.* 9; *Pl.* VI. *Fig.* 4)—and there appears to be no response of any kind on the part of the host. The cell walls do not seem to be affected by the fungus, and no trace of enzyme action could be discerned.

The pycnidia of the fungus are formed immediately below the epidermis, or at a depth of a few cells, and usually cause the latter to split away from the collapsed cortex. (*Pl.* V., *Fig.* 9; *Pl.* VI., *Fig.* 4.)

No conidial formation occurs on the host plant, but in old dried diseased shoots occasional chlamydospores are found. (*Pl.* V., *Fig.* 6.) These are frequently in organic connection with the Phoma mycelium. By teasing the tissues apart individual spores may be picked up on a glass hair and thus isolated. In size and appearance they resemble the chlamydospores found in artificial culture media. Of six spores tested in lavender extract three germinated and these only in ten, thirty and thirty-three days respectively. Of six spores digested with gastric juice, washed and placed in lavender extract, two germinated, both in about twelve hours. Unfortunately no growth of mycelium could be obtained from these spores, but there can be little doubt that they are homologous with the chlamydospores found in pure cultures of the fungus.

The minuteness of the pycnospores precluded the obtaining of definite information as to the manner in which they penetrate the host plant. It is to be noted, however, that under natural conditions the pycnospores are usually found in considerable number in or about the stomata, and that artificial infections very often appear to centre in a stoma.

Relation of Spores to Temperature and Desiccation.—A number of observations were made on the relation between the germinative capacity of the spores of the fungus, and various degrees of temperature and desiccation. The results are summarised in a tabulated form on pages 126–9.

The hyaline thin-walled spores are very considerably less resistant than the brown thick-walled spore forms. Both the former, and the majority of the latter, are killed by exposure to a temperature of 53° C. for 17 hours. The hyaline conidia are on the whole more resistant than the pycnospores, but both forms are unable to withstand a temperature below zero. When, however, the pycnospores remain in the pycnidia they are considerably more resistant to low temperatures, and may even survive over winter in a germinable condition.

The thick-walled brown conidia and chlamydospores are immune to the action of frost, and exposure to such a temperature merely results in the curtailment or elimination of their resting period.

Prolonged desiccation rapidly destroys the germinative capacity of the pycnospores and hyaline conidia, but is almost without effect on the thick-walled spore forms.

Relation of spores to temperature and desiccation.

Room temperature approximately 14°—16° C.

Nutrient medium used for all experiments was aqueous extract of lavender shoots.

Treatment.	Spore.	Result.		Per cent. germination.
		Total number of spores.	Number of spores germinated.	
I. A suspension of spores in sterile water was smeared over six glass cover slips, and the films air dried. They were then placed in a paraffin oven at 53° C. for 17 hours. On removal a drop of nutrient medium was placed on the centre of each cover slip over the spores, and the cover slips inverted over Van Tieghem cells, and placed in a dark cupboard at room temperature.	Pycnospore ...	531	0	0
	Hyaline conidium.	327	0	0
	Brown conidium.	230	35 (After 27 days.)	15
	Chlamydospore	123	27 (After 27 days.)	22

Treatment.	Spore.	Total number of spores.	No. of spores germinated during first 17 hours in paraffin oven.	No. of spores germinated later.	Total number of spores germinated.	Per cent. germination.
II. Transfers were made from a suspension of spores in water to hanging drops of nutrient medium on six glass cover slips, and these inverted over Van Tieghem cells. They were placed in a paraffin oven at 53° C. for 17 hours, and then removed to a dark cupboard at room temperature.	Pycnospore ...	467	0	0	0	0
	Hyaline conidium.	218	0	0	0	0
	Brown conidium.	242	0	19 (After 27 days.)	19	8
	Chlamydospore	153	0	23 (After 27 days.)	23	15

Treatment.	Spore.	Result.		Per cent. germination.
		Total number of spores.	Number of spores germinated.	
III. Treatment as in I., but films placed for 17 hours in an incubator at 33-34° C.	Pycnospore ...	283	57 (In 24 hours.)	20
	Hyaline conidium.	320	74 (In 24 hours.)	23
	Brown conidium.	153	107 (After 27 days.)	70
	Chlamydospore	97	67 (After 27 days.)	69

Treatment.	Spore.	Total number of spores.	No. of spores germinated during first 17 hours in incubator.	No. of spores germinated later.	Total number of spores germinated.	Per cent. germination.
IV. Treatment as in II., but hanging drops placed for 17 hours in an incubator at 33-34° C.	Pycnospore ...	193	0	104 (During next 24 hrs.)	104	54
	Hyaline conidium.	121	0	66 (During next 24 hrs.)	66	55
	Brown conidium.	350	0	213 (After 27 days.)	213	61
	Chlamydospore	54	0	34 (After 27 days.)	34	63

Treatment.	Spore.	Result.			Per cent. germination.
		Total number of spores.	Number of spores germinated.		
V. Treatment as in I., but films placed for 17 hours in an incubator at 22-23° C.	Pycnospore ...	353	211	In 24 hours.	60
	Hyaline conidium.	201	127	In 24 hours.	63
	Brown conidium.	197	144	After 27 days.	73
	Chlamydospore	89	57	After 27 days.	64

		Total number of spores.	No. of spores germinated during first 17 hours in incubator.	No. of spores germinated later.		Total number of spores germinated.	
VI. Treatment as in II., but hanging drops placed for 17 hours in an incubator at 22-23° C.	Pycnospore ...	453	340	18	In 24 hours.	358	79
	Hyaline conidium.	320	230	10	In 24 hours.	240	75
	Brown conidium.	397	2*	301	After 27 days.	303	84
	Chlamydospore	156	0	135	After 27 days.	135	86

		Result.			
		Total number of spores.	Number of spores germinated.		
VII. Treatment as in I., but films placed for 17 hours in a dark cupboard at room temperature 14-16° C.	Pycnospore ...	327	206	During 24 hours.	63
	Hyaline conidium.	404	258	During 24 hours.	64
	Brown conidium.	233	184	After 27 days.	79
	Chlamydospore	135	101	After 27 days.	75

		Total number of spores.	No. of spores germinated during first 17 hours in cupboard.	No. of spores germinated later.		Total number of spores germinated.	
VIII. Treatment as in II., but hanging drops left for 17 hours in a dark cupboard at room temperature 14-16 C.	Pycnospore ...	125	117	0	During next 24 hrs.	117	94
	Hyaline conidium.	300	255	3	During next 24 hrs.	258	86
	Brown conidium.	99	4*	84	After 27 days.	88	89
	Chlamydospore	84	0	71	After 27 days.	71	84

* It is probable that these spores had not properly thickened their walls.

Treatment.	Spore.	Result.		Per cent. germination.
		Total number of spores.	No. of spores germinated after removal to room temperature.	
IX. Treatment as in I., but films placed in a capsule, which was then sealed, and left exposed to a temperature below freezing point for 17 hours.	Pycnospore ...	417	8 During 24 hours.	2
	Hyaline conidium.	372	11 During 24 hours.	3
	Brown conidium.	197	146	74
	Chlamydospore	230	162	80
		Total number of spores.	No. of spores germinated within 24 hours of removal from cold to room temperature.	No. of spores germinated during next 24 hours.	Total number of spores germinated.	
X. Treatment as in II., but hanging drops placed in a capsule, and left exposed to a temperature below freezing point for 17 hours.	Pycnospore ...	473	0	0	0	0
	Hyaline conidium.	231	1*	4*	5	2
	Brown conidium.	303	180	11	191	63
	Chlamydospore	187	135	5	140	75
		Total number of spores.	Spores germinated during first 24 hours after removal.	Spores germinated during next 24 hours.	Total number of spores germinated.	
XI. Treatment as in I., but films left in a dark cupboard at room temperature for 7 days.	Pycnospore ...	715	438	12	450	63
	Hyaline conidium	451	265	17	282	62
	Brown conidium	461	2	0	2	4
	Chlamydospore	250	0	0	0	0
XII. Treatment as in I., but films left in a dark cupboard at room temperature for 33 days.	Pycnospore ...	583	23	10	33	6
	Hyaline conidium	414	41	15	56	13
	Brown conidium	195	150	14	164	84
	Chlamydospore	123	95	7	102	83

* It is probable that those spores were thick-walled brown conidia.

Treatment.	Spore.	Result.				Per cent. germination.
		Total number of spores.	Spores germinated in first 24 hours.	No. of spores germinated during next 24 hours.	Total number of spores germinated.	
XIII. Spores subjected to the action of artificial gastric juice for 12 hours, then washed, and placed in a hanging drop of lavender extract in a Van Tieghem cell at room temperature.	Pycnospore ...	265	1	0	1	4·4
	Hyaline conidium	123	3	0	3	3
	Brown conidium	97	64	16	80	82
	Chlamydospore	69	51	3	54	78
XIV. Suspension of spores in sterile water frozen for about 14 minutes, and subsequently covered by a hanging drop of nutrient medium in a Van Tieghem cell, and kept at room temperature.	Pycnospores ...	521	2	0	2	4·4
XV. Pycnidia teased from shoot, and suspended in water. Then frozen to slide for about 14 minutes. Picked out with glass hair, and placed in sterile water. Crushed, and loopfuls transferred to nutrient medium in a Van Tieghem cell.	Pycnospores ...	267	97	6	103	38

The Action of certain Enzymes on the Spores.—The pycnospores and hyaline conidia are killed by treatment with pepsin for twelve hours (artificial gastric juice, 100 c.c. of 0·4 per cent. hydrochloric acid added to 0·2 grams of pepsin dissolved in 100 c.c. of water). The effect of similar treatment on the thick-walled brown spore forms is to eliminate their resting period and render them capable of germination in a few hours. This result is apparently identical with that produced when the spores are subjected to a temperature below zero. One important point, however, is to be noted. Under normal conditions the spores are able to withstand repeated freezings, but after treatment with pepsin for twelve hours they are killed if exposed to frost for seventeen hours. Prolonged immersion in gastric juice or repeated alternate periods of immersion and desiccation reduce the germinative capacity of the spores. Spores which have passed through their resting period and are therefore immediately germinable are still resistant to repeated freezings, but not to repeated treatment with pepsin.

Treatment with trypsin (5 c.c. of Benger's liquor pancreaticus + 5 c.c. of 0·5 per cent. sodium carbonate) gave results much more variable but in effect substantially similar to those of pepsin.

Dilute solutions of diastase of malt, and invertase fairly rapidly reduced the germinative capacity of the thin-walled conidia and pycnospores, and slowly that of the brown thick-walled spores. No effect on the duration of the resting period of the latter was observed.

Conclusion.—The life history of *Phoma lavandulae* on its host plant is simple. The overwintering of the fungus and spring infection of the host is by means of the occasional chlamydospores, and pycnospores remaining in pycnidia, present in decaying fragments of old diseased shoots. The rapid spread of the disease during the summer months is due to the pycnospores which are produced in immense numbers. By the removal of all affected shoots as soon as noted, and if possible before pycnidia are formed, the disease may be kept in check.

Summary.—A serious disease of the genus *Lavandula* is caused by *Phoma lavandulae*, Gabotto, a fungus which is here recorded for England.

In pure culture on nutrient media the fungus produces hyaline thin-walled pycnospores, hyaline thin-walled conidia—which later become thick-walled and brown—and thick-walled brown chlamydospores.

The thin-walled spores germinate almost immediately, are little resistant to desiccation and are killed by frost.

The thick-walled spores are fairly resistant to prolonged desiccation, and only germinate after a resting period which may be eliminated by freezing or the action of pepsin or trypsin.

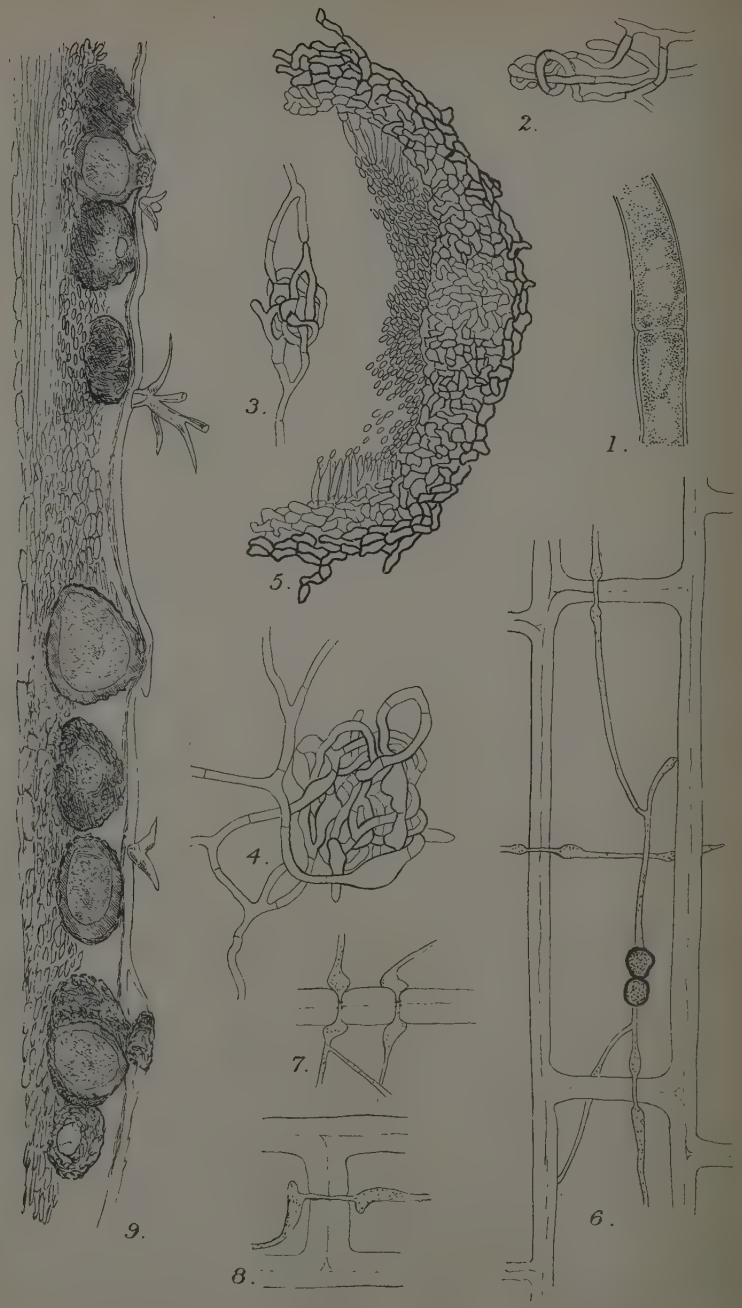
All spore forms germinate freely in vegetable nutrient media and the optimum temperature for the growth of the mycelium is about 18–20° C.

The development of the pycnidium is described and observations indicating that its orientation is conditioned by its relation to the food supply.

Infection experiments were carried out and demonstrated the pathogenicity of the fungus to the genus *Lavandula* and the fact that the fungus is probably confined to this genus.

The fungus mycelium ramifies throughout the host tissues and causes the cortex and phloem groups to collapse. The hyphae pass from cell to cell through the abundant pits in the walls.

The pycnidia are formed immediately below the epidermis which is lifted away from the cortex. Conidial formation is absent from the normal life cycle but chlamydospores are occasionally formed.



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(Notice page 131.)

Phoma lavandulae.

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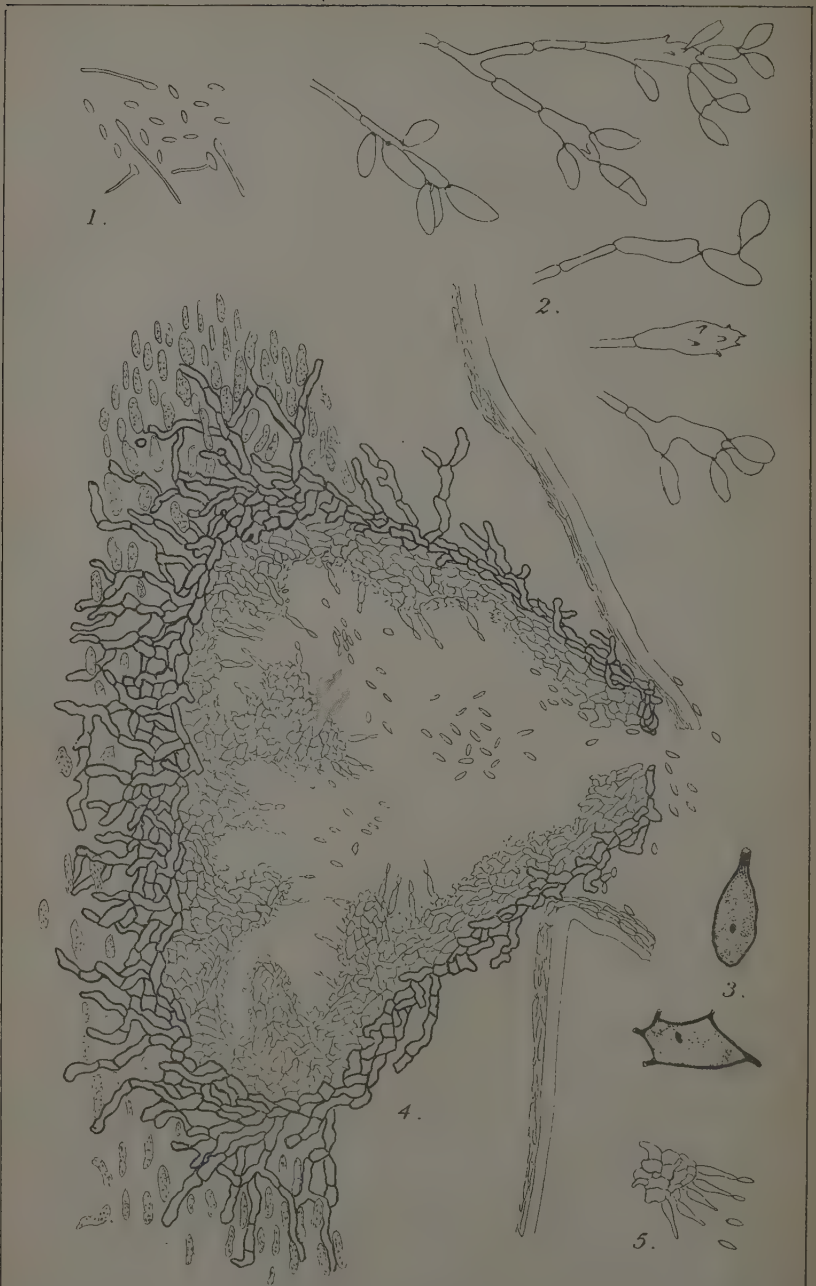

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To face page 131.] Phoma lavandulae.

EXPLANATION OF PLATES.

PLATE V.

Fig. 1.—Formation of transverse wall in hypha by the ingrowth of a ring-like diaphragm of cell wall substance. (Leitz $\frac{1}{12}$ oil immersion × 8 oc.)

Figs. 2, 3 *and* 4.—Young stages in the formation of pycnidia. (Swift $\frac{1}{6}$ obj. × III. eyepiece.)

Fig. 5.—Swelling in wall tissues at the position of the future ostiole. This drawing was made from a specimen immediately prior to dehiscence; the pycnospores are ready to emerge. (Swift $\frac{1}{6}$ obj. × III. eyepiece.)

Fig. 6.—Chlamydospores of fungus in host tissue. (Swift $\frac{1}{6}$ obj. × III. eyepiece.)

Figs. 6, 7 *and* 8.—Passage of hyphae through cell walls of host. In the pit the hypha is constricted but dilates at points of entry and exit. (Swift $\frac{1}{6}$ obj. × III. eyepiece.)

Fig. 9.—Longitudinal section of a lavender stem attacked by the fungus. The developing pycnidia have lifted the epidermis away from the collapsed cortical tissues. (Swift $\frac{2}{3}$ obj. × I. eyepiece.)

PLATE VI.

Fig. 1.—Pycnospores germinating on lavender extract at room temperature. (Swift $\frac{1}{6}$ obj. × III. eyepiece.)

Fig. 2.—Formation of thin-walled conidia on prune gelatine at room temperature. Note the very characteristic necks formed at point of abstriction. (Swift $\frac{1}{6}$ obj. × III. eyepiece.)

Fig. 3.—Thick-walled brown conidia from same culture as 2 but eight days later. (Swift $\frac{1}{6}$ obj. × III. eyepiece.)

Fig. 4.—Vertical section of a mature dehisced pycnidium growing on its host. Note the collapsed cortex and lifted epidermis, the basal stroma of thick-walled hyphae and the ingrowths from the wall tissue into the receptacle. (Swift $\frac{1}{6}$ obj. × III. eyepiece.)

Fig. 5.—Basidia abstricting spores. (Swift $\frac{1}{6}$ obj. × III. eyepiece.)

XXIII.—DECADES KEWENSES

PLANTARUM NOVARUM IN HERBARIO HORTII REGII CONSERVATARUM.

DECAS LXXXVIII.

871. **Glyptopetalum Lawsonii,** *Gamble* [Celastraceae-Celastreae]; species *G. zeylanico*, Thwaites, affinis, foliis coriaceis apicem versus tantum grosse serratis, cymis 7-floris axillaribus vel supra-axillaribus differt.

Frutex erectus, glaber, ramulis crassis glabris supremis paullo complanatis. *Folia* opposita vel subalterna, elliptico-obovata vel elliptica, apice acuta, obtusa vel interdum emarginata, basi cuneata, 5–9 cm. longa, 3–6 cm. lata, coriacea, siccitate pallide viridia, integra vel apicem versus dentibus paucis (3–4) grosse serrata; costa crassa, nervis lateralibus utrinsecus 7–9 elevatis inter se reticulatione conspicua junctis; petioli crassi, 5 mm. longi. *Cymae* axillares vel supra-axillares, dichotomae, 6–7-florae; pedunculus 2–3 cm. longus, complanatus, ad apicem bracteolis 2 oblongis 4 mm. longis munitus; rami primarii 8–10 mm. longi, bracteolis parvis muniti, secundarii circiter 4–5 mm. longi, etiam bracteolis parvis ad mediam partem instructi. *Calyx* 4-lobus, lobis brevibus ad apices nigro-scariosis.

Petala 4, ovata, obtusa, 3 mm. longa, foveolis binis obliquis apicem versus munita. *Stamina* 4; filamenta brevia, crassa, antherarum thecis divergentibus. *Ovarium* cum disco conicum, loculis 4 uniovulatis, stylo brevi. *Capsula* (immatura) subglobosa, glabra, 1·4 cm. lata, seminibus conspicue arillatis.

South India. Nilgiri Hills, *Wight;* Sigúr Ghát, North Nilgiris, *M. A. Lawson;* Geddesala Ghát, Coimbatore, *A. W. Lushington.*

872. **Microtropis Stocksii,** *Gamble* [Celastraceae-Celastreae]; species *M. latifoliae,* Wight, affinis, foliis minus coriaceis ellipticis vel oblanceolatis apice acutis, nervis subtus conspicuis, capsula oblonga differt.

Arbor, ramulis nigro-violaceis teretibus interdum rugosis. *Folia* elliptica vel oblanceolata, apice acuta, basi cuneata, 7–15 cm. longa, 2·5–6·5 cm. lata, coriacea, marginibus reflexis, nervis utrinsecus 8–10 prope marginem arcuatim junctis, secundariis ut reticulatione subtus conspicuis supra obscuris; petioli crassi, 5–7 mm. longi. *Flores* parvi, in axillis foliorum vel foliorum delapsorum glomerati. *Sepala* 5, ovata, inaequalia, margine dentata. *Petala* 5, unguiculata, ungue cum disco connato. *Discus* annularis, circiter 1 mm. latus. *Stamina* 5, and marginem disci inserta, filamentis subulatis, antheris suborbicularibus. *Ovarium* conicum, striatum. *Capsula* ovato-vel obovato-oblonga, laevis, apice acuta, 1·5–2 cm. longa. *Cotyledones* plani, elliptici.

South India. Coorg, *Hohenacker* 454; Concan, *Stocks;* Anamalai hills of Coimbatore District at Aiyarpadi, Paralai, etc., *C. A. Barber* 3839, 3899, 3971, 5418 (coll. 1901–1903); without definite locality, *Wight* 447 (partly).

Owing partly to there being several sheets of Wight's 447 clearly not collected from the same plant, this species has been confused with *M. latifolia,* of which I take the type to be the specimen collected at Sispara, Nilgiris, and named by Wight. In Dr. Cooke's Flora of Bombay it is described as *M. latifolia.* Dr. Barber's fine series of specimens clearly show it to be distinct from *M. latifolia,* especially in the size, shape and texture of the leaves.

873. **Hippocratea Bourdillonii,** *Gamble* [Hippocrateaceae]; species *H. obtusifoliae,* Roxb., affinis, foliis oblongis magis coriaceis basi rotundatis marginibus recurvis, petalis dorso mucronatis et disco apice puberulo differt.

Frutex scandens, ramulis subcrassis ultimis quadrangularibus. *Folia* oblonga, apice subito acuta, basi rotundata, 6–10 cm. longa, 3–4 cm. lata, coriacea, glabra, lucida, marginibus recurvis, aliquando apicem versus parce crenulata; costa conspicua; nervi laterales utrinsecus circiter 12, marginem versus arcuatim juncti, reticulatione ramosa conspicua. *Cymae* dichotomae, axillares, ad 3 cm. longae, pedunculo 2 cm. longo, bracteolis ad nodos ramorum ovato-acutis parvis. *Calyx* perbrevis, puberulus, lobis ovatis. *Petala* e basi lato lanceolata, acuminata, 5 mm. longa,

dorso ad apicem mucronata, intus pubescentia. *Discus* conspicuus, subcylindricus, apice puberulus, basi annulatus. *Stamina* 3, puberula, primum erecta, deinde recurva, antherarum thecis 2 medio transverse fissis. *Ovarium* disco immersum, stylo subulato. *Fructus* ignotus.

South India. Travancore; near Colatoorpolay, 100 m. alt., in evergreen forest, Feb. 1894, *T. F. Bourdillon* 158.

874. **Salacia malabarica,** *Gamble* [Hippocrateaceae]; affinis *S. reticulatae*, Wight, foliis majoribus oblongis chartaceis, pedicellis longioribus gracilibus, petalis albo-marginatis differt.

Frutex scandens, ramulis nigro-purpureis conspicue lenticellatis. *Folia* opposita, oblonga, apice obtusa, basi paullo attenuata, 8–16 cm. longa, 4–7 cm. lata, chartacea, glabra, margine obscure et remote serrata, nervis lateralibus utrinsecus 7–10 marginem versus curvatis, reticulatione obscura; petioli crassi, circiter 1 cm. longi. *Flores* parvi, e tuberculis axillaribus vel lateralibus fasciculati, 2–12-nati, 5 mm. lati; pedicelli graciles, 1·2–1·5 cm. longi. *Calyx* minutus, lobis 5 parvis ovatis. *Petala* oblonga, glabra, albo-marginata. *Discus* crassus, ovarium cingens. *Stamina* 3, intra marginem disci affixa, recurvata, filamentis brevibus, antherarum thecis transverse fissis. *Stylus* conicus, minutus. *Fructus* ignotus.

India. Madras Presidency; plains of S. Canara, *Beddome;* moist forest at the foot of the Travancore hills, *T. F. Bourdillon.*

875. **Salacia Beddomei,** *Gamble* [Hippocrateaceae]; species *S. macrospermae*, Wight, affinis, foliis majoribus, nervis lateralibus magis regularibus, calycis lobis fimbriis ferrugineis magis conspicue munitis differt.

Frutex, ramulis crassis brunneis minute lenticellatis. *Folia* opposita, elliptico-oblonga, apice breviter et abrupte acuta, basi subrotundata, 12–14 cm. longa, 5–7 cm. lata, coriacea, glabra, margine paullo undulata, nervis lateralibus circiter 12 primum rectis pone horizontalibus marginem versus arcuatim junctis, reticulatione conspicua; petioli crassi, rugosi 7–8 mm. longi. *Flores* parvi, e tuberculis axillaribus 4–12-floris fasciculati, circiter 3 mm. lati; pedicelli graciles, vix 5 mm. longi. *Calyx* minutus, lobis concavis ovatis fimbriis ferrugineis conspicue munitis. *Petala* obovata, glabra, 1·5 mm. longa. *Discus* magnus, fere cylindricus, ovarium cingens. *Stamina* 3, intra marginem disci inserta, reflexa, filamentis brevibus crassis, antherarum thecis globosis transverse dehiscentibus. *Stylus* conicus, exsertus. *Fructus* ignotus.

India. Madras Presidency; Anamalai hills of Coimbatore, *Beddome.*

876. **Salacia Talbotii,** *Gamble* [Hippocrateaceae]; species *S. macrospermae*, Wight, affinis, foliis angustioribus oblanceolatis, pedicellis gracilibus, fructu juventute saltem conspicue tuberculato differt.

Frutex scandens, ramulis teretibus brunneis minute lenticellatis divaricatis. *Folia* opposita, oblanceolata, apice abrupte acuta, basi in petiolum longe attenuata, 6-12 cm. longa, 3-4 cm. lata, coriacea, utrinque glabra, marginibus obscure undulatis recurvis; nervi laterales circiter 8, irregulares, ramosi, reticulatione infra conspicua; petioli graciles, 5–7 mm. longi. *Flores* parvi, in fasciculis multifloris e tuberculis axillaribus glomerati, vix 3 mm. lati; pedicelli graciles, 5 mm. longi. *Calyx* minimus, lobis 5 obtusis, margine dentato fimbriis ferrugineis munito. *Petala* oblonga, obtusa crassa, marginibus albescentibus. *Discus* pulvinatus, ovarium arcte cingens. *Stamina* 3, recurvata, filamentis brevibus latis, antherarum thecis transverse dehiscentibus. *Stylus* brevis, exsertus, conicus. *Fructus* globusus, aurantiacus, ad 4 cm. diametro, juventute eximie tuberculatus, deinde rugosus. *Semina* 2 vel pluria, complanata, oblonga, cotyledonibus conferruminatis.

India. Bombay Presidency; Ainshi Ghát in N. Canara, up to 560 m. alt., *W. A. Talbot* 1217, 1361.

877. **Ventilago Goughii,** *Gamble* [Rhamnaceae–Ventilagineae]; species *V. calyculatae*, Tul., affinis, foliis oblongo-lanceolatis obtusis parvis et calycis tubo fructifero cupuliformi ad tertiam nucis partem solum adnato differt.

Frutex scandens, ramulis gracilibus griseo-puberulis. *Folia* oblongo-lanceolata, apice obtusa vel abrupte acuta, basi attenuata, 6–7 cm. longa, 2–3 cm. lata, chartacea, apicem versus obscure serrata, supra glabra, subtus praeter costam griseo-puberulam glabra; nervi laterales utrinsecus 12–15, marginem versus curvati et nervulis transversis numerosis inconspicuis parallelis juncti. *Flores* parvi, in glomerulis parvis secus ramulos panicularum axillarium vel lateralium circiter 7 cm. longarum. *Paniculae* griseo-puberulae, ramulis brevibus; bracteae et bracteolae lineares, caducae; flores circiter 3 mm. diametro. *Calyx* extra puberulus, intus glaber. *Petala* minuta, lata, cucullata. *Stamina* filamentis brevibus, antheris oblongis connectivo apiculato. *Discus* glaber. *Ovarium* villosum; styli 2, breves. *Samara* circiter 5 cm. longa, oblonga, reticulata, 1 cm. lata, parce puberula, nuce ad basin tubo calycis ad tertiam partem circumdato.

South India. Coorg, *Viscount Gough* 1838; Coonoor Ghát, Nilgiris, *M. A. Lawson.*

878. **Ventilago lanceolata,** *Gamble* [Rhamnaceae–Ventilagineae]; *V. maderaspatanae*, Gaertn., affinis, foliis oblongo-lanceolatis acuminatis, floribus minutis, ovario glabro et calycis tubo fructifero patelliformi basi nucis solum adnato differt.

Frutex scandens, ramulis teretibus glabris vel juventute puberulis tandem nigrescentibus. *Folia* oblongo-lanceolata, apice acuminata, mucronata, basi inaequaliter subrotundata, 6–10 cm. longa, 2–4 cm. lata, chartacea, praecipue apicem versus crenata, juniora subtus puberula, tandem glabra; nervi laterales utrinsecus 6–8, marginem versus curvati et nervulis transversis permultis parallelis horizontalibus juncti. *Flores*

minuti, in glomerulis parvis secus ramulos sinuatos panicularum axillarium vel lateralium fere sessiles. *Paniculae* graciles, ferrugineo-villosae, 2–7 cm. longae, ramulis paucis vix 1 cm. longis; bracteae caducae; bracteolae sub glomerulis plures lineares; flores vix 2·5 mm. diametro. *Calyx* extra villosus, intus glaber. *Petala* minuta, lata, cucullata. *Stamina* fere sessilia, connectivo nigro apice recurvo. *Discus* glaber, complanatus. *Ovarium* glabrum; styli 2, brevissimi. *Samara* circiter 5 cm. longa, oblanceolata, parce puberula, reticulata, vix 1 cm. lata, juventute ferrugineo-tomentosa, nuce ad basin in calycis tubo persistente patelliforme insidenti.

South India. Kanota, Malabar District, Dec., 1913, *C. A. Barber;* Tinnevelly Ghâts, etc., 1873, *Beddome.*

Ceylon: Hantame; at 600 m., *Gardner* 180; *Walker* 169.

879. **Turpinia malabarica,** *Gamble* [Staphyleaceae]; species *T. nepalensi,* Wall., affinis, floribus et fructibus majoribus, foliolis ellipticis tenuioribus abrupte et longe cuspidato-acuminatis differt.

Arbor, ramulis crassis, cortice brunneo. *Folia* opposita, imparipinnata, ad 30 cm. longa, 2–3-juga, subcoriacea, glabra; foliola elliptica, serrata, apice abrupte cuspidato-acuminata, 10–12 cm. longa, 4–5 cm. lata, acumine obtuso, terminalis et laterales subaequales; nervi laterales utrinsecus 5–6, curvati et prope marginem gradatim arcuatim juncti, nervulis transversis horizontalibus reticulatione infra conspicua; petiolus communis 6–10 cm. longus; petiolulus terminalis 3–5 cm. longus, laterales 0·5–1·5 cm. longi; stipulae foliaceae, deciduae. *Inflorescentia* axillaris, ad 18 cm. longa, ramis et ramulis oppositis in cymas desinentibus; bracteae et bracteolae caducae. *Sepala* 5, ovata, ciliata, 2 mm. longa. *Petala* 5, obovata, 3 mm. longa, ciliata, puberula. *Discus* brevis, crenatus. *Stamina* 5, filamentis parce villosis, antheris globosis. *Ovarium* 3-lobatum, glabrum, stylis connatis, stigmatibus capitatis. *Drupa* subglobosa, crassa, 1–3-locularis, 3-apiculata. *Semina* complanata.

South India. Concan, *Law & Stocks;* Anamalai hills in Coimbatore, *C. A. Barber* 3906, 4068, 5720; Travancore hills, 640 m. alt., *Beddome* 241; *T. F. Bourdillon.*

880. **Buchanania Barberi,** *Gamble* [Anacardiaceae-Mangifereae]; *B. Lanzan,* Spr., et *B. lanceolatae,* Wight, affinis, ab hac foliis apice obtusis subtus juventute villosis et nervis lateralibus rectis parallelis, ab illa foliis multo angustioribus differt.

Arbor, ramulis siccitate griseo-brunneis scabris. *Folia* oblongo-elliptica, apice obtusa vel brevissime acuta, basi attenuata, 8–13 cm. longa, 3–5 cm. lata, coriacea, supra lucida, subtus juventute ferrugineo-villosa, deinde glabra; costa crassa, supra impressa et carinata, infra conspicua; nervi laterales utrinsecus 16–20, recti, paralleli, a costa sub angulo circiter 75° abeuntes, prope marginem tantum curvati, supra paullo impressi, subtus prominentes; petioli 1 cm. longi. *Paniculae* ferrugineo-villosae, patentes, ramosae, ad 10 cm. longae, bracteis et bracteolis ovato-acutis munitae,

pedicellis 2–3 mm. longis. *Calyx* minimus, dentibus acutis villosis. *Petala* oblonga, acuta, glabra, 2·5 mm. longa. *Stamina* 10, filamentis gracilibus 1 mm. longis curvatis, antheris angustis. *Discus* crassus, crenulatus. *Carpella* basi villosa; fertile ovoideum. *Fructus* maturus adhuc ignotus.

South India. Travancore, Nadarai, Nov., 1904, *C. A. Barber* 6737.

XXIV.—DIAGNOSES AFRICANAE: LXVII.

1581. **Gnidia Flanagani,** *C. H. Wright* in Dyer, Fl. Cap. vol. v. sect. 2, p. 53, anglice [Thymelaeaceae-Euthymelaeeae]; species G. *coriaceae*, Meisn., affinis, ramis erectis parallelisque (nec divergentibus) distinguitur.

Suffrutex erectus, usque ad 3 dm. altus; rami erecti, stricti, glabri. *Folia* opposita, ovato-lanceolata, 1·2 cm. longa, 5 mm. lata, acuta, glabra, trinervia. *Flores* caulis apice congesti. *Calyx* glaber; tubus 1 cm. longus, parte inferiore paullo inflatus, supra expansus; lobi ovati, acuti, 3 mm. longi, 2 mm. lati. *Petala* 4, membranacea, 2 mm. longa, 1·5 mm. lata. *Antherae* vix 1 mm. longae, superiores exsertae filamentis brevibus crassis instructae. *Ovarium* oblongum, compressum; stylus calycis tubo aequilongus, rigidus; stigma penicillatum.

South Africa. Komgha Div.; grassy hills near Keimouth, *Flanagan* 621. Transkei; grassy slopes, Kentani, 15 m., *Miss Pegler* 32. Pondoland; grassy places between Umkwani and Omsakabo, *Tyson* 2636.

The erect parallel branches give this a facies very different from that of *G. coriacea*, Meisn., in which they are divergent.

1582. **Gnidia Galpini,** *C. H. Wright* in Dyer, Fl. Cap. vol. v. sect. 2, p. 55, anglice [Thymelaeaceae-Euthymelaeeae]; species *G. decurrenti*, Meisn., proximus, calycis lobis ovatis differt.

Suffrutex diffuse ramosus; rami glabri, rubescentes. *Folia* opposita, oblongo-lanceolata, acuminata, 1·2 cm. longa, 3 mm. lata, glabra, infra punticulata, marginibus involutis parte superiora. *Flores* ramorum apicibus germinati. *Calyx* glaber; tubus 7 mm. longus, infra cylindricus, supra late infundibuliformis; lobi ovati, obtusi, 3 mm. longi, 2 mm. lati. *Petala* 4, membranacea, elliptica, obtusa, 2 mm. longa, 1·5 mm. lata, hyalina. *Antherae* breviter oblongae, obtusae, 1 mm. longae, superiores exsertae filamentis brevibus rigidibus instructae. *Ovarium* oblongum, compressum, coma terminali instructum; stylus calycis tubo aequilongus, rigidus; stigma penicillatum.

South Africa. Riversdale Div.; Garcias Pass, 360 m., *Galpin* 4519.

This resembles *G. styphelioides*, Meisn., but differs in having a glabrous calyx. The stems are wiry.

1583. **Gnidia Cayleyi,** *C. H. Wright* in Dyer, Fl. Cap. vol. v. sect 2, p. 57, anglice [Thymelaeaceae-Euthymelaeeae]; species G. *linoidi*, Wikstr., proximus, foliis elliptico-oblongis differt.

Planta 5–20 dm. alta, lignosa; rami recti, tenues, pubescentes. *Folia* opposita, elliptico-oblonga, acuta, 7 mm. longa, 1·5 mm. lata, glabra. *Flores* solitares, terminales. *Calyx* extra appresse sericeus; tubus 5 mm. longus, parte inferiore ovoideus, parte superiore infundibuliformis; lobi elliptici, 3 mm. longi, 1·5 mm. lati, acuti. *Petala* 8, minuta, antheris multo minora. *Antherae* oblonga, obtusae, vix 1 mm. longae. *Ovarium* compressum, glabrum; stylus excentricus, filiformis, calycis tubo fere aequilongus; stigma penicillatum.

South Africa. Without precise locality, *Herb. Caley in Herb. Kew.*

This much resembles *G. parvula*, Wolley-Dod, but differs in the small petals. A note on the sheet states that it agrees with a specimen in the Berlin Herbarium, collected on Table Mountain by Bergius.

1584. **Gnidia ericoides,** *C. H. Wright* in Dyer, Fl. Cap. vol. v. sect. 2, p. 58, anglice [Thymelaeaceae-Euthymelaeeae]; species ex affinitate *G. obtusissimae*, Meisn., a qua foliis linearioblongis homomorphis distinguitur.

Suffrutex nanus, ericoideus; rami erecti, robusti, primum pubescentes. *Folia* opposita, approximata, lineari-oblonga, 6 mm. longa, vix 1 mm. lata, obtusa, primum leviter pubescentia, mox glaberrima. *Flores* ad ramorum apices aggregati. *Calyx* extra appresse sericeus; tubus 1·2 cm. longus, infra ovoideus, supra infundibuliformis, costatus; lobi ovati, acuti, 4 mm. longi, 2·5 mm. lati. *Petala* 8, antheras simulantia, oblonga, obtusa, glabra, 2 mm. longa. *Antherae* 1 mm. longae, obtusae. *Ovarium* ovoideum, apice pilosum; stylus filiformis, 6 mm. longus; stigma penicillatum.

South Africa. Riversdale Div.; Tygerfontein, 184 m., *Galpin* 4523.

1585. **Gnidia Woodii,** *C. H. Wright* in Dyer, Fl. Cap. vol. v. sect. 2, p. 60, anglice [Thymelaeaceae-Euthymelaeeae]; species *G. setosae*, Wikstr., affinis, foliis latioribus calyceque multo longiore differt.

Suffrutex erectus; rami virgati, primum pilis longis paucis instructi, mox glabri, cicatricibus parvis notati. *Folia* alterna, lanceolata vel oblongo-lanceolata, 2 cm. longa, 2–2·5 mm. lata, acuminata, glaberrima, uninervia. *Flores* pauci, ad ramorum apices posita. *Calyx* extra hirsuta, lutea (*Wylie*); tubus 1·6 mm. longus, infra paullo inflatus, supra cylindricus. *Lobi* ovati, 4 mm. longi, 1·5 mm. lati, acuti. *Petala* 8, lanceolata, crassa, 2 mm. longa, vix 0·5 mm. lata. *Antherae* oblongae, obtusae, 1 mm. longae. *Ovarium* oblongum, apice pilosum; stylus 1 mm. longus; stigma capitatum.

South Africa. Griqualand East; near Fort Donald, 1530 m., *Tyson* 1639. Natal; on grassy slopes, Inanda, *Wood* 153, 755;

near Pinewood, *Wood*. Zululand; Ingotye, *Wood*, and without precise locality, 1224–1530 m., *Wylie in Herb. Wood* 9014.

1586. **Gnidia Baurii,** *C. H. Wright* in Dyer, Fl. Cap. vol. v. sect. 2, p. 61, anglice [Thymelaeaceae-Euthymelaeeae]; species distinctissima, *G. Woodii*, C. H. Wright, affinis, foliis subtus sericeis habituque flaccidiore differt.

Suffrutex diffusus; rami graciles, debiles, primum pilosi, foliorum cicatricibus parvis prominentibus instructi. *Folia* opposita, lanceolata, acuminata, 1·2 cm. longa, 3 mm. lata, supra glabra, subtus appresse sericea. *Flores* geminati, terminales. *Calyx* extra sericeus; tubus 8 mm. longus, subtus ovoideus, supra anguste infundibuliformis; lobi ovati, 2 mm. longi, 1·5 mm. lati, acuti. *Petala* 8, oblonga, obtusa, 1 mm. longa, crassa. *Antherae* breviter oblongae, parvae, superiores exsertae, filamentis tenuibus instructae. *Ovarium* oblongum, apice pilosum; stylus gracilis, calycis tubo brevior; stigma parvum.

South Africa. Tembuland; Bazeia Mountain, 1070 m., *Baur* 732.

1587. **Gnidia Leipoldtii,** *C. H. Wright* in Dyer, Fl. Cap. vol. v. sect. 2, p. 64, anglice [Thymelaeaceae-Euthymelaeeae]; species ex affinitate *G. sericeae*, Linn., floribus quam folia multo longioribus differt.

Frutex multiramosus; rami diffusi, graciles, primum pubescentes, demum glabri et cicatricibus prominentibus instructi. *Folia* opposita, ovato-oblonga, acuta, 1·4 cm. longa, 6 mm. lata, utrinque dense appresse sericea, 1–3-nervia. *Flores* 2–6 ad ramorum apicem posita. *Calyx* dense tomentosus; tubus 1·4 cm. longus, leviter costatus, infra inflatus, supra subcylindricus; lobi ovales, 3 mm. longi, 2 mm. lati. *Petala* 8, vix 1 mm. longa, antheras simulantia, emarginata. *Antherae* petalis aequilongae, sed angustiores, obtusae. *Ovarium* ovoideum, apice pilosum; stylus filiformis, 8 mm. longus; stigma penicillatum.

South Africa. Calvinia Div.; Nieuwoudtville, Willems River and Bokkeveld Mountains, 612–918 m., *Leipoldt* 882. Somerset East Div.; on mountain sides near Somerset East, 1224 m., *Bolus* 1764.

1588. **Gnidia nitida,** *Bolus ex C. H. Wright* in Dyer, Fl. Cap. vol. v. sect. 2, p. 64, anglice [Thymelaeaceae-Euthymelaeeae]; species *G. Leipoldtii*, C. H. Wright, affinis, foliis multo minoribus calyceque apprese sericeo differt.

Frutex diffuse ramosus; rami graciles, rigidi, primum hirsuti, mox glabrescentes, obscure tetragoni, foliorum cicatricibus parvis prominentibus instructi. *Folia* ad ramorum apices congesta, ovalia, rotundata vel subacuta, 6 mm. longa, 2 mm. lata, primum appresse sericea, demum glabra, obscure trinervia, marginibus parte superiore inflexis. *Flores* ad ramorum apices geminati. *Calyx* extra dense sericeus, luteus (*Bolus*); tubus 1·4 mm. longus, infra inflatus, supra anguste infundibuliformis; lobi 4 mm. longi, 2·5 mm. lati, subacuti. *Petala* 8, antheras simulantia,

2·5 mm. longa, obtusa. *Antherae* lineares, 1·5 mm. longae, obtusae. *Ovarium* compressum, glabrum; stylus filiformis, 8 mm. longus; stigma penicillatum.

South Africa. Little Namaqualand; in stony places near Ookiep, 900 m., *Bolus in Bolus & MacOwan, Herb. Norm. Austr.-Afr.* 689.

1589. **Lasiosiphon canoargentea,** *C. H. Wright* in Dyer, Fl. Cap. vol. v. sect. 2, p. 70, anglice [Thymelaeaceae-Euthymelaeeae]; species *L. splendenti*, Endl., affinis, foliis oblongo-lanceolatis brevioribus petalisque dentiformibus differt.

Frutex multiramosus; rami primum dense appresse albosericei, foliorum cicatricibus parvis prominentibus instructi. *Folia* alterna, oblongo-lanceolata, 1 cm. longa, 2·5 mm. lata, acuta, pilis appressis argenteis praecipue ad paginam inferiorem dense vestita; folia involucralia quam caulina duplo latiora. *Flores* plures, terminales. *Calyx* extra pubescens, pilis inferioribus quam superiores longioribus; tubus 1·2 cm. longus; lobi oblongi, obtusi, 3 mm. longi, 2 mm. lati. *Petala* minuta, dentiformia. *Antherae* quam petala triplo longiorae, oblongae, obtusae, 1 mm. longae. *Ovarium* oblongum, apice pilosum; stylus gracilis, rigidus, calyce aequilongus; stigma capitatum.

South Africa. Transvaal; Witte Kranz, near Lydenburg, *Wilms* 1298; on the sides of mountains near Lydenburg, *McLea in Herb. Bolus* 3020.

1590. **Lasiosiphon Wilmsii,** *C. H. Wright* in Dyer Fl. Cap. vol. v. sect. 2, p. 71, anglice [Thymelaeaceae-Euthymelaeeae]; species *L. Burchellii*, var. *glabrifolio*, Meisn., affinis, foliis obtusis differt.

Frutex ramosissimus; rami primum pilosi, rubescentes, foliorum cicatricibus parvis instructi. *Folia* alterna, brevissime petiolata, oblonga, acuta, 1·4 cm. longa, 3·5 mm. lata, glabra, coriacea, costa subtus prominente; folia involucralia caulinis majora, pilosa. *Flores* plures, terminales, ad vesperum suaveolentes (*Cooper*). *Calyx* extra dense sericeus; tubus 1·2–1·4 cm. longus, cylindricus; lobi aurantiaci (*Cooper*), oblonga, obtusa, 4 mm. longa, circiter 2 mm. lata. *Petala* minuta. *Antherae* 1·5 mm. longae, petalis triplo longiores, obtusae. *Ovarium* oblongum, glabrum; stylus calycis tubo aequilongus; stigma capitatum.

South Africa. Orange River Colony; Witteberg, *Rehmann* 3943. Basutoland; without precise locality, *Cooper* 696. Transvaal; by the Vaal River near Kloete, *Wilms* 1299. By the Crocodile River in Lydenburg District, *Wilms* 1299b.

This species resembles *L. anthylloides*, Meisn., but differs in having quite glabrous leaves (except the involucral) and a shorter calyx-tube.

XXV.—THE ARBORETUM AT TREGREHAN, CORNWALL.

W. J. Bean.

There are between a dozen and twenty gardens whose fame has spread over the whole country, and whose names we have come to regard as synonymous with Cornish gardening. But amongst them few would include Tregrehan, the seat of the Carlyon family. It is, indeed, a curious circumstance that so little should have been heard of this garden, which in the number, size and vigour of certain classes of trees and shrubs occupies a foremost place, not only in Cornish gardens but in those of the entire British Islands. Most of the species were planted, I believe, by the late Mr. George Carlyon, thirty to forty years ago. In the following notes a few of the more striking trees and shrubs are mentioned, but they do not profess to include all worthy of note.

Tregrehan has its full complement of rhododendrons, but they are so common to Cornish gardens, especially those of Himalayan origin, and have so often been mentioned in these pages that a detailed account of them is unnecessary. *R. Ungernii*, a Caucasian species, is allied to, and came into cultivation at the same time (1886) as, *R. Smirnowi*, but has remained a very scarce plant. At Tregrehan there is a fine bush 10 ft. high and 10 ft. through, in perfect health. A still rarer rhododendron, *R. Hookeri*, perhaps the scarcest in cultivation now of Himalayan species, is also about 10 ft. high. *R. cinnamomeum*, one of the *arboreum* group, is frequent enough in Cornwall, but I do not know of any tree so fine and shapely as that at Tregrehan, or one so tall. It has the broadly columnar or slightly tapering form characteristic of the sort and is between 25 ft. and 28 ft. in height. In several places in Cornwall a rhododendron is grown very like *R. Falconeri* in general aspect, but still in several characters and in time of flowering showing the influence of *R. argenteum*. It was not in flower at the end of March, but is considered to be a hybrid between these two species. There is a noble bush at Tregrehan 18 ft. high, with leaves up to 18 in. long.

Tregrehan stands out, I think, above all the Cornish gardens for the richness and health of its conifers. Of the better known types like those one sees in the Perthshire properties, there are many fine examples, such for instance as *Picea hondoensis* with a trunk girthing 5 ft. 10 in.; *P. Omorica* about 40 ft. high (about as fine probably as will be found in the country); *P. polita*, most remarkable perhaps of all Japanese species, 4 ft. 3 in. in girth of trunk; *Abies bracteata*, so rarely seen in fine condition, has a trunk 6 ft. 8 in. in girth. *Abies Webbiana* and its ally *A. Pindrow* are good and healthy (the former 40 ft., the latter 28 ft. high), but finer trees can be found elsewhere. Nowhere, however, in our islands, so far as I know, is there such a fine tree of *Abies Mariesii*. First discovered and introduced from Japan in 1879 by Chas. Maries, this fir has always been extremely rare and at one time appeared to have almost completely fallen out of cultivation. During a tour through the famous conifer collections of Scotland about ten years ago I found but a single small plant, which was in the gardens of Scone Palace. Since then a few more trees have

been introduced from abroad. The species is evidently a slow-growing one and the tree at Tregrehan may belong to Maries' original importation; it is 30 ft. high, its trunk 1 ft. 6½ in. in circumference, and far exceeds in size any tree of which there is common knowledge in this country.

Of other Japanese firs, *Abies Veitchii* about 3 ft. in girth; *A. firma*, 4 ft. 6 in. in girth; and *A. brachyphylla*, 5 ft. 8 in. in girth, are all handsome and notable trees. *A. pectinata pendula*, a weeping form of common silver fir, makes a curious object; the branches are so pendulous and keep so close to the trunk that the whole tree, although 40 ft. high, is only a few feet in diameter. There is also a very fine example of *Abies cephalonica* var. *Apollinis*, a form of the Greek fir with leaves blunter than in the type and more crowded on the upper side of the twig.

Of pines, the most remarkable in the garden is *Pinus patula*, a very distinct species from Mexico with leaves three in each sheath, of a characteristic pale glaucous hue and very slender and pendulous. The foliage is so plentiful that the whole framework of the tree is hidden by this grey mantle. The tree at Tregrehan has a trunk 7 ft. 7 in. in circumference and its head of branches and leaves is a dome-like mass apparently over 50 ft. high. Another smaller tree is interesting, because it is grafted at 2 ft. from the ground on Scotch pine. No two pines differ more from each other than these, in spite of which the tree is very healthy, the trunk already somewhat about 1 foot in thickness. There is a good tree of *Pinus Montezumae* (its trunk 5 ft. 3 in. in girth), also from Mexico, but as different as possible from *P. patula* in its long, stiff leaves and gaunt open habit. The Macedonian pine (*P. Peuke*) is represented by a tree rather better than those in the collection at Kew which (now 45–50 ft. high) have generally been regarded as about the best in the country. There is also a good tree of the Arolla pine (*Pinus Cembra*) with the characteristic bushy habit of this species and about 45 ft. high.

I have heard an eminent botanist and great traveller say that he had never seen a really fine *Cryptomeria japonica* out of Japan. There is a tree at Tregrehan which does not, of course, rival the trees in the famous avenue at Nikko in Japan, but it is in perfect health, its trunk is 9 ft. 3 in. in girth and its branches make a flawless pyramid of luxuriant greenery. *Cunninghamia sinensis* is a much more unsatisfactory tree in this country, yet there is one here with a trunk 6 ft. 2 in. in circumference. *Thuya dolabrata*, in perfect condition, is 30 ft. high.

With the exception of the two Mexican pines noted above, all the conifers hitherto mentioned are hardy enough to thrive in many other parts of the kingdom, and they cannot be regarded as typical of Cornish gardens, although rarely are they to be found in such splendid condition as at Tregrehan. But there is besides a very interesting assemblage of conifers from the Southern Hemisphere, more especially Chile and Australasia—regions of the globe which, next to the Himalaya, furnish the most characteristic vegetation of these south-western gardens. *Dacrydium cupressinum*, a graceful and distinct species from New Zealand but very rare in gardens, is 12 ft. high; and *Libocedrus Doniana* from the same country is about as tall. There are several trees of the curious

Tasmanian genus *Athrotaxis*. Of the three species known the rarest is *A. selaginoides*, here a slender pyramid 25 ft. high; *A. laxifolia* is 20 ft. high, and *A. cupressoides* is also represented. Of the interesting genus *Podocarpus* there are several representatives at Tregrehan: *P. Totara* of New Zealand is 25 ft. high; *P. macrophylla* from Japan is 12 ft.; and *P. chilina* is 30 ft. high, very graceful and beautiful, but scarcely so fine as the noted tree at Penjerrick. Closely allied to the Podocarps are *Prumnopitys elegans*, here 25 ft. high, and *Saxegothea conspicua*, 20 ft., both Chilean. Native of the same region is *Fitzroya patagonica* of which there is a spreading bushy tree 26 ft. in height, its trunk 3 ft. 10 in. round, very graceful because of the long pendulous terminal parts of the branches.

Apart from rhododendrons the most notable Himalayan plants at Tregrehan are an *Ilex insignis* 30 ft. high, its stem 1 ft. 3 in. in girth, one of the noblest of hollies; *Tsuga Brunoniana*, rarest of hemlocks, its trunk 4 ft. in girth; *Berberis asiatica*, 18 ft. high, its stem 2 ft. 3 in. round, a species allied to the well-known *B. aristata*, but with larger, harder leaves glaucous beneath and much more tender; and *Euonymus fimbriatus*, only known further north as a small bush in greenhouses, but here a small tree of shapely pyramidal form 22 ft. high, its trunk 4 ft. in circumference. There is also a good specimen of an oak one very rarely sees, the Himalayan *Quercus semicarpifolia*; it is evergreen and a large-leaved ally of *Q. Ilex*.

One of the most remarkable of evergreens in this garden is a plant of *Daphniphyllum glaucescens*, a large bush with rhododendron-like leaves and 20 ft. high by 24 ft. in diameter. Two Japanese hollies also are noteworthy: *Ilex cornuta*, 10 ft. high and 15 ft. through, and *I. crenata* 12 ft. in height. *Photinia serrulata* is a tree 35 ft. high and 45 ft. in diameter, notable for its red fruits and the bronzy red of its young foliage.

A tree of great interest is a specimen of *Eucalyptus cordata*. This, which I was told was planted less than thirty years ago, is now about 60 ft. high, its trunk 5 ft. in girth, dimensions considerably in excess of any recorded by Elwes in connection with this species in this country. It is one of the most striking features of this garden with its smooth tapering trunk and conspicuous head of glaucous foliage. It flowers very abundantly, even in the young state. Unlike most eucalypts, *E. cordata* does not change the character of its foliage in passing from the juvenile to the adult stage. *Panax longissimum*, that curious New Zealand tree with leaves 2 ft. long but only 1 in. to 2 in. wide, the midrib rich yellow, the margins coarsely toothed, is 15 to 20 ft. high. *Drimys aromatica*, not uncommon in the south-west, is 10 ft. high and 8 ft. through.

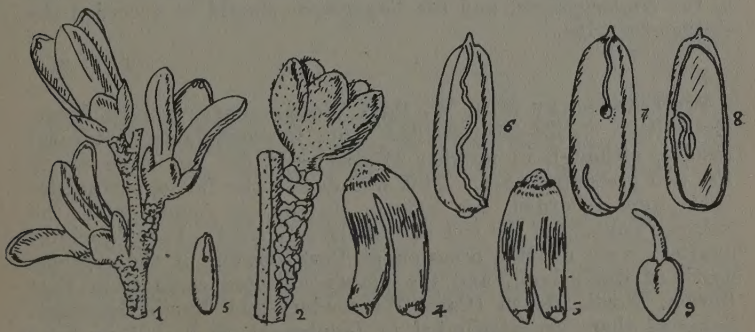
The trees and shrubs here mentioned by no means exhaust the interest of Tregrehan. A visit of two hours, such as mine, was not sufficient to examine adequately all its treasures. But enough perhaps has been written to show that few places can claim to possess so many exotic species of trees of so high an average of distinction, together with so many that may be regarded as the best of their kind in these islands.

XXVI.—MISCELLANEOUS NOTES.

Botanical Magazine for June.—The plants figured are *Aloe arborescens* var. *natalensis*, Berger, from Natal (t. 8663); *Saxegothaea conspicua*, Lindl., from Chile (t. 8664); *Rhododendron charianthum*, Hutchinson, from Western China (t. 8665), and *Campanula Zoysii*, Wulf, from North Italy and Austria (t. 8666).

The Fruit of Soyauxia.—The genus *Soyauxia* was referred by Oliver,* who described it, "to a group of erect *Passifloreae*† almost confined to West Tropical Africa," and was regarded by him "as connecting these with *Samydaceae* through *Dissomeria*." Warburg transferred this group to the *Flacourtiaceae* as a new tribe *Paropsieae*,‡ which included two sub-tribes: *Soyauxieae*, based on *Soyauxia*, and *Euparopsieae*, including the remaining genera.§

Gilg recognised three species‖ of *Soyauxia* in his account of African *Flacourtiaceae*,¶ and two more have been described recently.**



1, open fruits; 2, fruiting calyx, showing corky decurrent pedicel; 3 and 4 valves; 5, seed, showing depression above micropyle; 6 and 7, seeds showing raphe and micropyle respectively; 8, longitudinal section of seed; 9, embryo.—1 and 5 natural size, the remainder enlarged.

The fruit of *Soyauxia* has hitherto been known only from the description†† of *S. grandifolia*: "*Capsula* pedicello valde incrassato semigloboso insidens, basi calyce persistente cincta, valvis 3 late obovatis duris 1 poll. longis fere 1 poll. latis dehiscens." A fine series of fruiting specimens of an apparently undescribed species of *Soyauxia* has been collected in Sierra Leone by Mr. H. N. Thomas, and a more complete description of the fruit and seed of *Soyauxia* can now be given:

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* Hook. Ic. Pl. t. 1393 (1882).

† *Paropsia*, *Smeathmannia* and *Barteria*.

‡ Engl. and Prantl, Nat. Pflanzenfam. vol. iii. 6A, p. 25 (1893).

§ *Hounea*, *Paropsia* (incl. *Smeathmannia*), *Paropsiopsis* and *Barteria*.

‖ *S. gabonensis*, *S. glabrescens*, *S. grandifolia*.

¶ Engl. Jahrb. vol. xl. p. 469 (1908).

** *S. Talbotii*, E. G. Baker in Journ. Bot. 1914, p. 4; *S. floribunda*, Hutchinson in Kew Bull. 1915, p. 44.

†† Journ. Linn. Soc. Bot. vol. xxxvii. p. 102 (1905).

Capsula basi calyce persistente cincta, monosperma, ab apice fere ad basin in valvas tres dehiscens; valvae stylorum cicatricibus alternantes, demum saepius recurvae, a medio ad basin et fere ad apicem in duo segmenta longitudinaliter findentes. *Semen* albuminosum, pendulum, trigonum, a latere visum anguste oblongum, laeve, nitidulum, micropyla basi foveae circularis supra medium seminis sita; albumen corneum, copiosum; embryo longitudine $\frac{1}{4}$–$\frac{1}{3}$ seminis metiens, radicula a micropyla descendente cum cotyledonibus angulum magnum efficiente.

The valves of the capsule bear half a style-scar at each side of their apex. They apparently open elastically, probably no resemblane to the pitted seeds of the *Euparopsieae*, and it is seed, with its basin-shaped depression above the micropyle, bears shooting out the seed in the process. The large smooth trigonous evident that the relationship with this group has been exaggerated. *Soyauxia* was known to differ from the *Euparopsieae* in its inflorescence, anthers, stigmas, placentation and small number of ovules; and now that its peculiar seeds are known, it is evident that the tribe *Paropsieae* should be restricted to the *Euparopsieae*, and the *Soyauxieae* should be accorded the status of a tribe.

T. A. S.

Presentation by Mrs. W. Paul Wood.—Parry's third Arctic Expedition (1824–25) yielded not inconsiderable botanical results, although in number of species it did not come up to the two preceding ones. This was due to the few opportunities that were afforded for officers to go on shore and the extreme poverty of the soil in the places visited. Parry's winter quarters were on this occasion at Port Bowen, at the extreme north of Baffinsland, and the plants collected came from Port Bowen, North Devon (Cape Warrender) and North Somerset. Some of them are attributed to Lieutenant Ross, but in most cases no collector's name is given. A portion of them were deposited in Hooker's herbarium and are now at Kew, mostly without exact indication of the station where they were collected. The plants enumerated comprised 66 phanerogams, 1 fern, 1 lycopodium, 3 mosses and 12 lower cryptogams. A few weeks ago another set of plants collected on the same expedition came to hand. They are in excellent condition, and in each case the locality is given. Kew owes this interesting contribution to the generosity of Mrs. W. Paul Wood, of Bath, who is now in her 89th year, but still takes interest in the little collection of Arctic plants which many years ago was given into her charge. It consists of 41 phanerogams, 1 lycopodium, and several mosses. They are all contained in Hooker's list, and are mostly from the same localities. Although they do not extend our knowledge of that far northern vegetation, they are nevertheless a valuable addition to the Kew collections, in as far as they supplement the incomplete set in the possession of Kew and are generally better specimens. Who the collector may have been has so far not been ascertained.

O. S.
